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Program Development Through Formative Evaluation: The SWRL Instructional Concepts Program

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PROGRAM DEVELOPMENT THROUGH FORMATIVE EVALUATION: THE SWRL INSTRUCTIONAL CONCEPTS PROGRAM

Roger O. Scott

ABSTRACT

The SWRL Instructional Concepts Program has been developed to help kindergarten children quickly learn conceptual skills which are fundamental to academic achievement. Formative evaluation procedures employed in the 1968-69 tryout were primarily responsible for the changes incorporated into the present program. These procedures included teacher interviews, observations of lessons being taught, student tests for each unit of the program, and collection and analysis of pretest and posttest performance data. It is expected that the revised Instructional Concepts Program will be more effective for students and more acceptable to teachers because of the revisions resulting from the formative evaluation procedures.

PROGRAM DEVELOPMENT THROUGH FORMATIVE EVALUATION: THE SWRL INSTRUCTIONAL CONCEPTS PROGRAM

Recent literature in educational research and development has emphasized the use of formative evaluation procedures. Formative evaluation emphasizes the collection of data during, rather than after the development of an instructional program. The information obtained through this type of evaluation is used to make appropriate revisions in instructional materials and teaching procedures.

Central to the development of instructional programs at the Southwest Regional Laboratory for Educational Research and Development (SWRL) is the use of systematic formative evaluation procedures. In the early stages of program development, individual components of the instructional package are tested in a small number of classrooms. Later, the entire program is tested in many classrooms that are representative of those for which the instruction is intended. Each of these tryouts is designed for the purpose of collecting information relevant to appropriate program revisions. The tryout/revision cycle is repeated until the program is proven effective.

The application of formative evaluation to the initial preparation and improvement of an instructional program can be illustrated by the development of the SWRL Instructional Concepts Program. This is a one-semester program designed to teach kindergarten children to respond appropriately to 86 concept words. This paper describes the use of formative evaluation procedures in the initial tryout and first revision of the 1968-69 Instructional Concepts Program.

Method

Instructional Program

The Instructional Concepts Program helps kindergarten children learn to respond appropriately to a large number of concept words. Included in these objectives are colors, sizes, positions, and amounts. The program is designed to teach children to name and identify examples of each concept.

Instruction to teach the concepts was, in the initial version of the program, incorporated into 32 lessons, each lesson focusing on two to four concepts. Lessons consisted of a short story built around the concepts and large poster illustrations of the story. Materials for several optional activities were also provided. These included instructional games, flashcards, and practice exercises for each student. Each teacher received a manual which contained the stories and games for all lessons and a description of the recommended teaching procedures.

The program was divided into five instructional units. Criterion exercises to be used by the teacher in assessing the concept skills of the children were prepared for each unit.

Subjects

More than 200 kindergarten children in three California schools took part in the 1968-69 tryout of the Instructional Concepts Program. Two schools were located in the inner city of a large urban district. The other school was located in a small community in an agricultural region. These tryout schools were selected on the basis of scores on a 10-item pretest which sampled the skills to be taught in the program. The test was individually administered to a small sample of students in each of five schools. Mean scores were below 50% correct for the three schools which were selected. The participation of two other schools was rejected because of higher scores.

Most of the children in the three schools were from low-income families. Approximately one-half of the children in the tryout were Negro; nearly all of the other children were Mexican-American.

School Liaison

Before the tryout began, a teacher orientation meeting was held at SWRL. At the conclusion of the tryout, the teachers attended a day-long conference devoted to revisions of the program. Throughout the 15 week tryout, staff members made numerous phone calls and visits to the schools. In addition, the five unit tests which were administered by the teachers were returned to the Laboratory for scoring and summarizing. These results were then given to the teachers.

Instructional Outcomes

To determine what concepts children should know, Laboratory staff members reviewed several first-grade curriculum guides in current use. These materials make certain implicit assumptions concerning the conceptual abilities of first graders. For instance, the curriculum guide which advises, "Tell the children to turn to the next page," implies that students will know concepts such as "turn," "next," and "page." Concepts which occurred in at least two of the curriculum guides and which did not refer to specific objects (e.g., house, dog, tree, etc.), were adopted for the program. This list of concepts was revised on the basis of suggestions from primary-grade teachers and curriculum specialists and individual assessment of kindergarten children on tasks involving use of the various concepts. The result was a list of 86 concepts grouped into seven categories: color, size, shape, position, amount, time, and equivalence. A list of the concepts in each category appears in Appendix A.

Criterion Tests

Concept identification test. An identification test was constructed to measure children's knowledge of the concepts. Five concepts were randomly selected from six of the program's concept categories. An additional item tested a time concept.

One test item was constructed for each selected concept. An additional five items tested the use of concepts in conjunction. For example, children were asked to identify a triangle under a line. This tested two concepts: under and triangle. Concepts tested in conjunction were randomly sampled from those already selected for the test.

The required response in the test was the identification of the orally presented concept by pointing. The test had a total of 36 items, each consisting of a picture illustration of a concept and two distractors. Examples of test items used in each category appear in Appendix B.

The reliability coefficient for the individually administered instrument for 181 subjects taking the pretest was .75 (Kuder-Richardson 21).

Constructed response concept test. A concept naming test was constructed using 15 of the concepts and concept illustrations which were included in the identification test. Five color concepts, five shape concepts, and four amount concepts were tested, in addition to one item which measured the conjunctive use of concepts. Each child was asked questions such as "What color is this?" "What shape is this?" or "How many are there?" The reliability coefficient for the constructed response test was .55 (Kuder-Richardson 21).

Results and Discussion

Concept Identification

The children enrolled in the eight tryout classes made substantial improvements in their ability to identify concepts. Mean scores on the 36-item concept identification test were 23.82 before the program and 28.73 after the 15 weeks of instruction. These scores, when corrected for guessing, show a progression from 49% correct on the pretest to 70% correct on the posttest.

The corrected pretest and posttest concept identification scores for each class are presented in Table 1. There was considerable variation between classes with the percentage increase ranging from 14 to 28. There was a greater variation when the concept identification scores for each concept category were compared. These figures are presented

TABLE 1

MEAN PRETEST AND POSTTEST CLASS SCORES
FOR THE CONCEPT IDENTIFICATION TEST

CLASS	NUMBER OF STUDENTS	MEAN NUMBER CORRECT		MEAN PERCENTAGE CORRECT	
		PRETEST	POSTTEST	PRETEST	POSTTEST
1	14	22.29	27.32	62%	76%
2	17	19.77	25.59	55%	71%
3	12	19.62	27.12	54%	75%
4	15	19.31	25.40	54%	70%
5	19	16.82	26.93	47%	75%
6	22	16.10	22.23	45%	62%
7	15	15.11	23.40	42%	65%
8	19	15.00	24.32	42%	67%
TOTAL	133	17.73	25.10	49%	70%

NOTE: All of the scores presented above have been corrected for guessing. The test contained 32 three-choice items and four two-choice items.

in Table 2. Shape and position concepts showed the highest percentage gains--30 and 28 respectively. The least gain was in size concepts where scores increased on 11% over the pretest. There was still more variation when posttest scores of the concept categories were compared. At one extreme, children were nearly perfect in their ability to identify color concepts. At the low end were equivalence concepts, with a score of slightly over 50%, and the time concept which had a low score because the single item measuring the concept apparently cued a wrong response, judging by the less than chance results on the pretest.

The distribution of pretest and posttest scores is presented in Figure 1. An examination of these data shows that the shape of these distributions is significantly different ($F=1.83$, $df=132,132$). The standard deviation was reduced from 5.81 on the pretest to 4.29 on the posttest. This is an important result, since it reflects the fact that many of the children who made very low scores on the pretest narrowed the gap between themselves and the rest of the class.

Concept Naming

The concept naming skills were assessed after the 15 weeks of instruction. The scores were surprisingly high relative to the selected response scores of the concept identification test. Of a possible 15 correct, the mean was 12.60. The overall percentage score was 84. Because this test asked children to give the concept name of individually presented stimulus objects, there was no need to correct scores for guessing as in the case of the multiple-choice concept identification test. The mean scores for each concept category are presented in Table 3. The concept identification test scores for the same concept categories are also listed.

The data in Table 3 indicate that naming skills are either equal to or higher than identification skills. The reverse had been expected. Children might be able to point to an exemplar of a concept but not name it. The results are especially surprising since many of the children used Spanish as their first language. One possible answer involves the validity of the concept identification test. It is possible that some children who could identify a given amount concept did not do so on the identification test because of the counting required when the concept was presented with two distractors. A child might have to count three sets of objects before finding the right choice. In the naming test, the concept exemplar was presented without the distractors. Thus, a child could arrive at the answer with only one counting operation.

Control Group

Some of the increase in the conceptual skills of kindergarten children can be attributed to the traditional school program and

TABLE 2

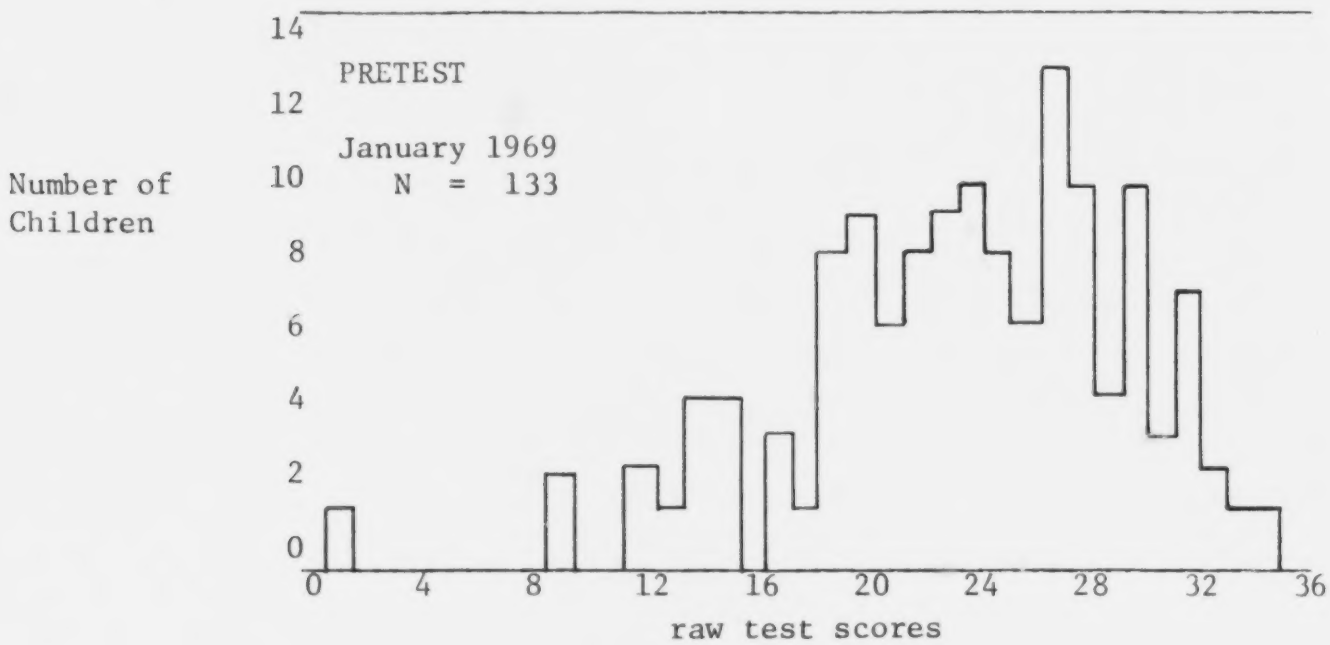
MEAN PRETEST AND POSTTEST CONCEPT CATEGORY SCORES
FOR THE CONCEPT IDENTIFICATION TEST

CONCEPT CATEGORY	MEAN NUMBER CORRECT		MEAN PERCENTAGE CORRECT	
	PRETEST	POSTTEST	PRETEST	POSTTEST
Color	3.98	4.78	80%	96%
Size	3.26	3.80	65%	76%
Conjunctive Concepts	2.75	3.98	55%	80%
Amount	2.41	3.20	48%	64%
Shape	1.84	3.34	37%	67%
Equivalence	1.82	2.71	36%	54%
Position	1.75	3.14	35%	63%
Time[a]	Less Than Chance	.15	Less Than Chance	15%
Total	17.73	25.10	49%	70%

NOTE: All of the scores presented above have been corrected for guessing.

[a]The Test contained only one item for the "Time" Category and five items each for the other seven categories.

Figure 1. Pretest and posttest distributions for the concept identification test.



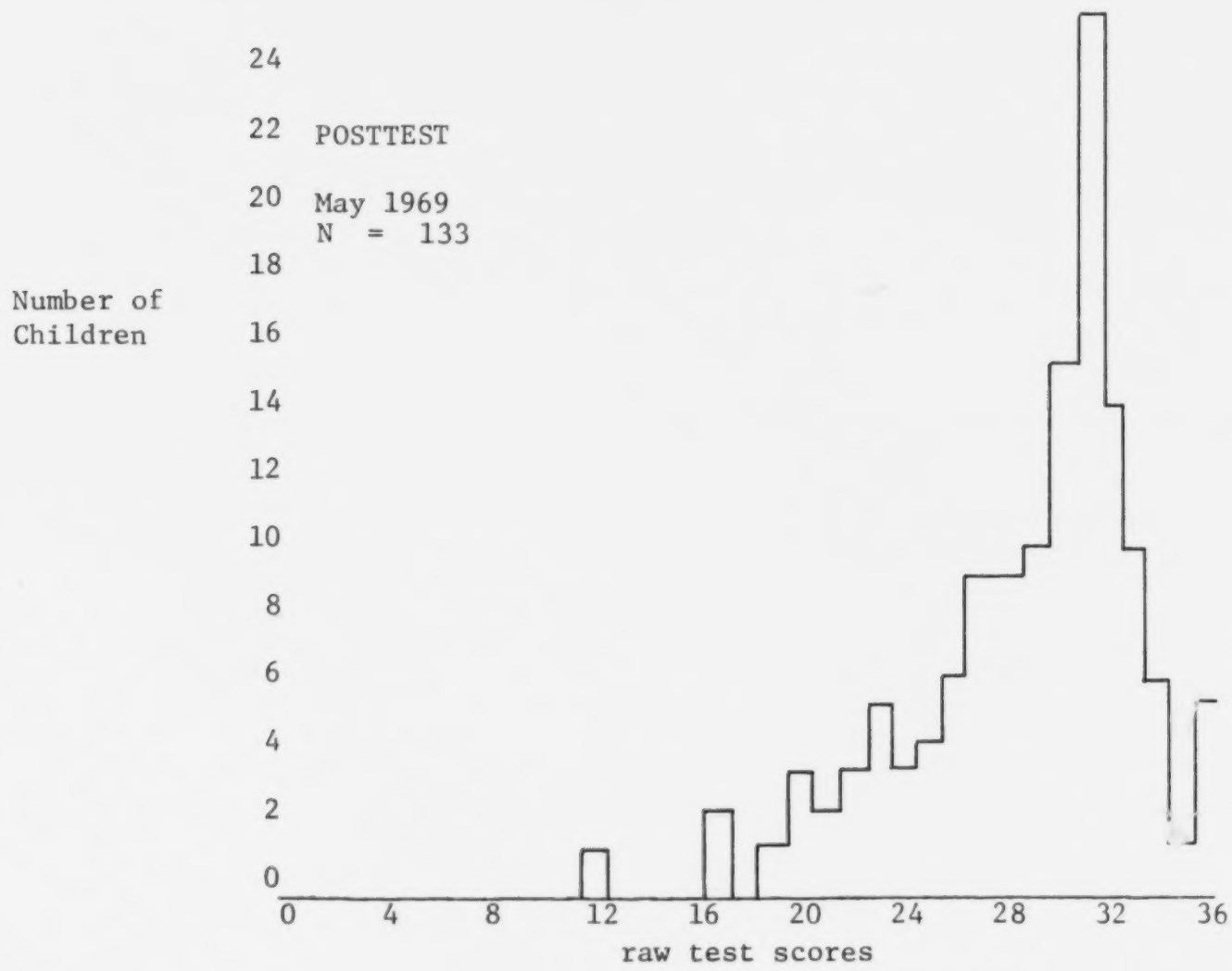


TABLE 3

MEAN CONCEPT CATEGORY SCORES
FOR NAMING AND POINTING TASKS

CONCEPT CATEGORY	CONCEPT NAMING TEST		CONCEPT IDENTIFICATION TEST (POINTING TASK)
	MEAN NUMBER CORRECT	MEAN PERCENTAGE CORRECT	MEAN PERCENTAGE CORRECT
Color[a]	4.84	97	96
Shape[a]	3.95	79	67
Amount[b]	3.02	76	64
Conjunctive Concepts[c]	.79	79	80
TOTAL	12.60	84	79

NOTE: Concept naming test scores not corrected for guessing.

[a]Five test items for naming
[b]Four test items for naming
[c]One test item for naming

extra-school experiences. To investigate the importance of these factors, the concept identification test was administered to 80 kindergarten children who were not involved in the tryout. The test was given to children from two inner city San Diego schools at the end of the school year. The children in these schools are from families with income levels similar to those in the tryout schools. The data from this test administration are reported in Table 4.

After instruction, the tryout children scored much higher than the comparison group. The scores show that the children who did not have access to the SWRL program were, at the end of the year, still close to beginning-of-the-year skills levels. It seems likely that the SWRL program enabled teachers to be more effective in teaching basic instructional concepts.

Program Revisions

A major purpose of the 1968-69 tryout was to increase the effectiveness of the program by identifying and incorporating improvements in the instructional materials and procedures. Formative evaluation data were of primary importance in making these revisions. These data included reports of participating teachers, classroom observations of SWRL staff, analyses of criterion exercise data, and suggestions of curriculum specialists from the participating districts.

Instructional Outcomes

Most of the concepts taught in the original Instructional Concepts Program are included in the revised program. Four concepts relating to prereading skills were added, since the program is used before children receive any reading instruction. The concept "not" was added at the request of teachers and curriculum specialists in the tryout schools. Although teachers liked the lessons dealing with pattern they agreed that these concepts were not critical for future academic performance and consequently they were dropped from the objectives. During the tryout many children had difficulty completing the group administered criterion exercises. For this reason ten concepts dealing with direction following skills were added to the program. These concepts include page, row, turn, mark and oval, and recognition of numerals 1, 2, 3, 4 and 5.

Sequence and Structure

The revised program is divided into seven units. Unlike the original version, each unit contains concepts related to a single dimension such as color, size or amount. This was done at the request of tryout teachers who felt that such an arrangement would

TABLE 4

MEAN CONCEPT CATEGORY SCORES
FOR THE CONCEPT IDENTIFICATION TEST

CONCEPT CATEGORY	CHILDREN WITH SWRL MATERIALS N = 133		COMPARISON GROUP N = 80
	PRETEST	POSTTEST	POSTTEST
Color	3.98	4.78	4.10
Size	3.26	3.80	3.11
Conjunctive Concepts	2.75	3.98	2.13
Shape	1.84	3.34	2.68
Position	1.75	3.14	1.18
TOTAL	13.58	19.04	13.20

NOTE: All of the scores presented above have been corrected for guessing.

Only the portions of the concept identification test which were identical in the administration to both groups are reported.

facilitate evaluation of student performance and scheduling of additional practice. The units were sequenced according to pretest data. Scores were highest on colors, so that unit was scheduled first; the next highest scores were on sizes, so the unit on sizes was sequenced second, and so on.

Instructional Components

The revised Instructional Concepts Program consists of 10 major components. Each component was revised on the basis of formative evaluation data.

Early in the tryout, it was determined that the format of the story illustrations would have to be changed. One poster was used to illustrate each of the stories in the revised program. Three cards were used to illustrate each story in the original program, but teachers reported that the posters were cumbersome. Lesson observations by SWRL staff also indicated that the posters were used in a manner which prevented children from frequently practicing the use of the concepts in the lesson. Teachers typically asked individual children to come to the front of the room and point to an instance of the concept illustrated on the poster. With a lesson conducted in this manner, many children did not have a chance to engage in appropriate practice. Others had only a very limited opportunity. In order to increase the frequency of practice, concept books were developed for the revised program. All children received a book for each of the program's seven units. These books are similar in format to the storybooks used in the SWRL Communication Skills Program. Each lesson is illustrated on two pages which face each other. The illustrations include the unit theme character and objects familiar to inner city kindergarten children. The illustrations also represent two or more instances of each concept included in that lesson. Concept naming and identifying questions to ask the class are listed in each book.

Practice exercises were also found in need of major revisions. In the original program a single page which illustrated the concepts to be taught was included for each lesson. This was an optional activity which teachers could hand out and ask children to color or mark. A number of teachers suggested that this component was not structured enough to be useful in the class. Because of these comments and because of a desire to coordinate the program with the SWRL Communication Skills materials, the practice exercises were completely revised. Each revised exercise consists of four pages with each page divided into five rows. Directions are printed in the margin of each row so that they can be read from the left hand side of the paper. These directions which can be used by the teacher, an aide, a parent, or a tutor ask the child to identify illustrated concepts by pointing and naming.

Other program components which underwent major format changes as a result of the tryout included games and the teacher's manual. Lesser changes were made for the flashcards, criterion exercises, training lessons for the criterion exercises, and the pre- and posttest. One component--concept cards--was added to the program at the request of several tryout teachers.

APPENDIX A

CONCEPTS AND CONCEPT CATEGORIES OF THE ORIGINAL AND REVISED INSTRUCTIONAL CONCEPTS PROGRAM

COLORS

Original	Revised
red	red
blue	blue
yellow	yellow
brown	brown
black	black
white	white
orange	orange
purple	purple
green	green
	pink

SHAPES

Original	Revised
circle	circle
square	square
triangle	triangle
rectangle	rectangle
straight-line	straight-line
curved line	curved line

SIZES

Original	Revised
larger	larger
smaller	smaller
shorter	shorter
longer	longer
taller	taller
largest	largest
smallest	smallest
medium-sized	
shortest	shortest
tallest	tallest
longest	longest
thin	
thick	
thicker	thicker
thinner	thinner
	thickest
	thinnest

AMOUNTS

Original	Revised
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
least	least
most	most
more	more
less	less
all	all
some	some
none	none
no	no

POSITIONS

Original	Revised
above	above
below	below
between	between
over	over
under	under
beside	beside
outside	outside
behind	behind
in front of	
next to	next to
around	around
top	top
bottom	bottom
side	side
front	front
middle	middle
end	end
1st	
2nd	2nd
3rd	3rd
4th	4th
back	back
beginning	beginning
first	first
last	last
	in front
	inside
	right
	left

COMPARISONS

Original	Revised
same	same
different	different
equal	equal
not equal	
	unequal
	not

PATTERNS

Original	Revised
striped	(none)
polka dotted	
checked	

PREREADING SKILLS

Original	Revised
(none)	sound
	name
	letter
	word

TIME

Original	Revised
before	before
after	after
	first
	last

APPENDIX B

EXAMPLES OF TEST ITEMS IN EACH CONCEPT CATEGORY IN THE 1968-1969 INSTRUCTIONAL CONCEPTS PROGRAM

1. COLOR

   "Point to the green bird."

2. SHAPE

   "Point to the circle."

3. SIZE

   "Point to the largest turtle."

4. AMOUNT

   "Point to the bowl with the most ice cream."

5. POSITION

   "Point to the monkey at the beginning of the line."

6. EQUIVALENCE

   "See this cat?" (Point to the cat in the margin.) "Point to a cat over here that is the same color."

7. CONJUNCTIVE

   "Point to the triangle under the line."

8. TIME

   (Point to each picture in turn and tell the following story.) "Here is a boy sleeping in bed in the morning. Now he wakes up. Here he is going to school. Point to the picture that shows the boy before he woke up."